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Comparison of Intercontinental Wireless and Wired Power Transmission

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Abstract. A crude economic comparison is made using past studies and contemporary estimates of wireless vs. wired power transmission systems in the range of 1 MW to 10 GW, for transmitting electric power between continents. The installed transmission system costs in terms of $/km-MW, excluding prime generating means and the ultimate load, but including DC-RF and AC-DC converters as appropriate, are plotted as a function of the transmitted power level.

Wired power systems considered are AC and DC open wire lines, undersea or buried cables, and buried TE01 mode microwave circular waveguides. Wireless power transmission systems consisting of fixed phased or retrodirective phased array transmitters and rectennas are costed for point-to-point paths on the Earth's surface for short ranges, and via orbiting reflectors for long range systems.

Transmission system losses are compared and discussed. Both the wired and wireless systems have right-of-way and electromagnetic field safety concerns, but only the wired, closed waveguide and shielded cables have in theory no radio interference problems. Earth curvature must be considered for relay, TE01 waveguides and the line-of-sight RF paths.

The well developed open wire lines are the lowest cost electric power transmission systems. However, to be truly intercontinental, transmission across a body of water is required. In the conventional case, undersea cables are typically utilized, and the cost is at least an order of magnitude over land based open wire lines.

Costs generally decrease with increasing power level for both wired and wireless systems, due to economies of scale. The quantity of data points is small, but the wireless power transmission system cost as estimated appear to be comparable to the undersea cables cost for the short range (e.g. Strait of Gibraltar, 15 km) but lower in cost for the longer range (e.g. Brazil to Martha's Vineyard floating Rectenna, ~ 6500 km) relay system.